

CLAIMS

1. A fuel cell assembly comprising:

a fuel cell (1) having first and second oxygen electrodes (4a,4b), a hydrogen electrode (3) and an electrolyte membrane (2) disposed between the hydrogen electrode (3) and the first and second oxygen electrodes (4a,4b);

a hydrogen gas channel (40) for supplying fuel gas containing hydrogen to the hydrogen electrode (3), the hydrogen gas channel (40) facing the hydrogen electrode (3);

a first oxidant gas channel (50a) for supplying oxidant gas to the first oxygen electrode (4a), the first oxidant gas channel (50a) facing the first oxygen electrode (4a);

a second oxidant gas channel (50b) for supplying the oxidant gas which has passed through the first oxidant gas channel (50a) to the second oxidant electrode (4b), the second oxidant channel (50b) facing the second oxygen electrode;

and a dehumidifier (6,8) for dehumidifying the oxidant gas which has passed through the first oxidant gas channel (50a), the dehumidifier (6,8) being disposed downstream of the first oxidant gas channel (50a) and upstream of the second oxidant gas channel (50b).

2. The fuel cell assembly as defined in Claim 1, further comprising a humidifier (7,8) for humidifying oxidant gas to be supplied to the first oxidant gas channel (50a), the humidifier applying water removed by the dehumidifier (6,8) to the oxidant gas to be supplied to the first oxidant gas channel (50a).

3. The fuel cell assembly as defined in Claim 2, wherein the dehumidifier (6,8) and the humidifier (7,8) constitute an integrated humidity regulation module (5), the humidity regulation module (5) comprising a humid air passage (6), a dry air passage (7) and a water permeable membrane (8) between the humid air passage (6) and the dry air passage (7), the water permeable membrane (8) allowing movement of water from the humid air passage (6) to the dry air passage (7),

and wherein the oxidant gas which has passed through the first oxidant gas channel (50a) further passes through the humid air passage (6) and the oxidant gas to be supplied to the first oxidant gas channel (50a) passes

through the dry air passage (7).

4. The fuel cell assembly as defined in Claim 3, wherein the integrated humidity regulation module (5) is directly connected to a side surface (130) of the fuel cell (1) so as to serve as an air manifold directly connected to the first and second oxidant gas channels (50a, 50b), the side surface (130) is substantially parallel to a direction of lamination of the fuel cell (1).

5. The fuel cell assembly as defined in Claim 4, wherein the humidity regulation module (5) comprises a plurality of water permeable membranes (108) each of which is a hollow fiber and the density of the plurality of water permeable membranes (108) decreases away from the fuel cell (1).

6. The fuel cell assembly as defined in Claim 4, further comprising an air supply passage (77) connected between the first oxidant gas channel (50a) and the dry air passage (7) of the humidity regulation module (5) and a fuel gas manifold (95b) for collecting fuel gas from the fuel gas channel (40), wherein the air supply passage (77) is integrated with the fuel gas manifold (95b).

7. The fuel cell assembly as defined in Claim 3, wherein a pressure regulation valve (12) is provided between an inlet (6a) of the humid air passage (6) and an outlet (7b) of the dry air passage (7).

8. The fuel cell assembly as defined in Claim 7, further comprising a controller (15) for controlling an opening of the pressure regulation valve (12) in response to power required by the fuel cell (1).

9. The fuel cell assembly as defined in Claim 1, further comprising a humidifier (8,37) for humidifying the fuel gas containing hydrogen to be supplied to the hydrogen gas channel (40), the humidifier (8,37) applying water removed by the dehumidifier (6,8) to the fuel gas to be supplied to the hydrogen gas channel (40).

10. The fuel cell assembly as defined in Claim 9, wherein the humidifier (8,37) and the dehumidifier (6,8) constitute an integrated humidity regulation module (5), and the humidity regulation module (5) comprises a

humid air passage (6), a dry fuel gas passage (37) and a water permeable membrane (8) between the humid air passage (6) and the dry fuel gas passage (37), the water permeable membrane allowing movement of water from the humid air passage (6) to the dry fuel gas passage (37),

and wherein the oxidant gas which has passed through the first oxidant gas channel (50a) further passes through the humid air passage (6) and the fuel gas to be supplied to the hydrogen gas channel (40) passes through the dry fuel gas passage (37).

11. The fuel cell assembly as defined in Claim 1, wherein the first oxidant gas channel (50a) is positioned on a downstream side with respect to the flow of the fuel gas and the second oxidant gas channel (50b) is positioned on an upstream side with respect to the flow of the fuel gas.

12. The fuel cell assembly as defined in Claim 1, wherein fuel gas flows in the hydrogen gas channel (40) in a substantially vertically downward direction.

13. The fuel cell assembly as defined in Claim 12, wherein oxidant gas flows in a substantially horizontal direction in the first and second oxidant gas channels (50a, 50b).

14. The fuel cell assembly as defined in Claim 1, wherein the first oxygen electrode (4a) facing the first oxidant gas channel (50a) and the second oxygen electrode (4b) facing the second oxidant gas channel (50b) are physically separate.

15. The fuel cell assembly as defined in Claim 1, wherein the first oxygen electrode (4a) facing the first oxidant gas channel (50a) and the second oxygen electrode (4b) facing the second oxidant gas channel (50b) are physically connected.

16. The fuel cell assembly as defined in Claim 14, wherein the first oxygen electrode (4a) is electrically connected to a first power regulation element (13) and the second oxygen electrode (4b) is electrically connected to a second power regulation element (14), the first and second power regulation element (13,14) are electrically connected to a positive terminal (17).

17. A fuel cell system comprising:

a fuel cell (1) having an electrolyte membrane (2), an air electrode (4) and a fuel electrode (3); the electrolyte membrane (2) being disposed between the air electrode (4) and the fuel electrode (3);

an air supply device (19) for supplying air to the air electrode (4);

a fuel gas supply device (20) for supplying fuel gas to the fuel electrode (3); and

a humidity regulation module (5) having a dry air passage (7) and a humid air passage (6) and allowing movement of water from the humid air passage (6) to the dry air passage (7);

wherein the air electrode (4) is divided into an upstream section (4a) and a downstream section (4b) with respect to a flow of supplied air;

air supplied from the air supply device (19) passes through the upstream section (4a) of the air electrode (4) after passing through the dry air passage (7) of the humidity regulation module (5); and

air discharged from the upstream section (4a) of the air electrode (4) is supplied to the downstream section (4b) of the air electrode (4) after passing through the humid air passage (6) of the humidity regulation module (5).